

CLAIMS

1. An article comprising:
5 a plurality of fill yarns and warp yarns woven to form a fabric having a fill yarn cover factor of at least about 75% and a warp yarn cover factor of at least about 100%,
the fabric including therein at least one fiber of a first type and at least one fiber of a type different from the first type.

10 2. The article as in claim 1, wherein the fabric has a fill yarn cover factor of at least about 80%.

15 3. The article as in claim 2, wherein the fabric has a fill yarn cover factor of at least about 85%.

4. The article as in claim 3, wherein the fabric has a fill yarn cover factor of at least about 88%.

20 5. The article as in claim 1, wherein the fabric has a warp yarn cover factor of at least about 110%.

6. The article as in claim 5, wherein the fabric has a warp yarn cover factor of at least about 120%.

25 7. The article as in claim 6, wherein the fabric has a warp yarn cover factor of at least about 130%.

8. The article as in claim 7, wherein the fabric has a warp yarn cover factor of at least about 140%.

30 9. The article as in claim 8, wherein the fabric has a warp yarn cover factor of at least about 145%.

10. The article as in claim 9, wherein the fabric has a warp yarn cover factor of at least about 150%.

11. The article as in claim 1, wherein the plurality of fill yarns and warp yarns 5 includes a first yarn comprising fibers of the first type and a second yarn comprising fibers of the type different from the first type.

12. The article as in claim 11, wherein the first yarn consists essentially of fibers of the first type and the second yarn consists essentially of fibers of the type different from 10 the first type.

13. The article as in claim 1, wherein the plurality of fill yarns and warp yarns includes at least one yarn comprising at least a first fiber bundle and a second fiber bundle, the first fiber bundle comprising fibers of the first type and the second fiber 15 bundle comprising fibers of the type different from the first type.

14. The article as in claim 13, wherein the plurality of fill yarns and warp yarns includes at least one yarn comprising at least a first fiber bundle and a second fiber bundle, the first fiber bundle consisting essentially of fibers of the first type and the 20 second fiber bundle consisting essentially of fibers of the type different from the first type.

15. The article as in claim 13, wherein the first fiber bundle and the second fiber bundle are plied together to form the yarn with a secondary ply twist of at least about $\frac{1}{4}$ 25 that of a primary twist of the first fiber bundle and the second fiber bundle.

16. The article as in claim 15, wherein the first fiber bundle and the second fiber bundle are plied together to form the yarn with a secondary ply twist of at least about $\frac{1}{2}$ that of a primary twist of the first fiber bundle and the second fiber bundle.

17. The article as in claim 1, wherein at least one of the fiber of the first type and the fiber of a type different from the first type is a fiber having a tensile breaking strength of at least about 10 g/Denier.

5 18. The article as in claim 17, wherein at least one of the fiber of the first type and the fiber of a type different from the first type is a fiber having a tensile breaking strength of at least about 15 g/Denier.

10 19. The article as in claim 18, wherein at least one of the fiber of the first type and the fiber of a type different from the first type is a fiber having a tensile breaking strength of at least about 20 g/Denier.

15 20. The article as in claim 19, wherein at least one of the fiber of the first type and the fiber of a type different from the first type is a fiber having a tensile breaking strength of at least about 25 g/Denier.

20 21. The article as in claim 20, wherein at least one of the fiber of the first type and the fiber of a type different from the first type is a fiber having a tensile breaking strength of at least about 30 g/Denier.

25 22. The article as in claim 17, wherein at least one of the fiber of the first type and the fiber of a type different from the first type is formed of a material selected from the group consisting of: para-aramids; liquid crystal polyesters; ultra-high molecular weight polyethylenes; and poly(p-phenylene-2,6-benzobisoxazole) (PBO).

23. The article as in claim 17, wherein each of the fibers of the first type and the fiber of a type different from the first type is a fiber having a tensile breaking strength of at least about 10 g/Denier.

30 24. The article as in claim 17, wherein the fiber of the first type is a fiber having a tensile breaking strength of at least about 10 g/Denier and the fiber of a type different from the first type has a tensile breaking strength less than about 10 g/Denier.

25. The article as in claim 24, wherein the fiber of a type different from the first type is formed of a material selected from the group consisting of: polyamides; cellulosic materials; polyesters; acrylic polymers; and polyolefins.

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26. The article as in claim 1, wherein the fabric includes therein at least one fiber bundle comprising at least one fiber of the first type and at least one fiber of a type different from the first type.

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27. The article as in claim 26, wherein at least one of the fiber of the first type and the fiber of a type different from the first type is a fiber having a tensile breaking strength of at least about 10 g/Denier.

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28. The article as in claim 27, wherein the fiber of the first type is a fiber having a tensile breaking strength of at least about 10 g/Denier and the fiber of a type different from the first type has a tensile breaking strength less than about 10 g/Denier.

29. The article as in claim 28, wherein the fiber bundle comprises a plurality of fibers, at least 5% of which are fibers of the first type.

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30. The article as in claim 29, wherein the fiber bundle comprises a plurality of fibers, at least 15% of which are fibers of the first type.

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31. The article as in claim 30, wherein the fiber bundle comprises a plurality of fibers, at least 25% of which are fibers of the first type.

32. The article as in claim 31, wherein the fiber bundle comprises a plurality of fibers, at least 50% of which are fibers of the first type.

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33. The article as in claim 32, wherein the fiber bundle comprises a plurality of fibers, at least 65% of which are fibers of the first type.

34. The article as in claim 33, wherein the fiber bundle comprises a plurality of fibers, at least 75% of which are fibers of the first type.

35. The article as in claim 34, wherein the fiber bundle comprises a plurality of fibers, at least 85% of which are fibers of the first type.

36. The article as in claim 28, wherein the fiber of the first type has a weight per unit length greater than that of the fiber of a type different from the first type.

37. The article as in claim 26, wherein each of the fiber of the first type and the fiber of a type different from the first type is a fiber having a tensile breaking strength of at least about 10 g/Denier.

38. The article as in claim 26, wherein any given cross-section of the fiber bundle along its length includes therein between about 60 and about 100 fibers.

39. The article as in claim 26, wherein the fiber bundle is formed of a plurality of spun staple fibers each having a length per unit weight exceeding about 50 Cotton Count and a weight per unit length less than about 106 Denier.

40. The article as in claim 39, wherein the fiber bundle is characterized by a primary twist multiplier of at least about 2.7.

41. An article of apparel formed, at least in part, of the article as in claim 1.

42. The article of apparel as in claim 41, wherein the article of apparel is selected from the group consisting of: gloves; aprons; chaps; pants; boots; gators; shirts; jackets; coats; socks; shoes; undergarments; vests; waders; hats; and gauntlets.

43. A method comprising the step of:
weaving together a plurality of fill yarns and warp yarns into a woven fabric having a fill cover factor of at least about 75%, a warp yarn cover factor of at least about

100%, and including therein at least one fiber of a first type and at least one fiber of a type different from the first type.

44. An article comprising:

5 a fiber bundle formed of a plurality of fibers including at least one fiber of a first type having a tensile breaking strength of at least about 10g/Denier, the fiber bundle having a length per unit weight exceeding about 50 Cotton Count and a weight per unit length less than about 106 Denier.

10 45. The article as in claim 44, wherein the fiber of the first type has a tensile breaking strength of at least about 15 g/Denier.

46. The article as in claim 45, wherein the fiber of the first type has a tensile breaking strength of at least about 20 g/Denier.

15 47. The article as in claim 46, wherein the fiber of the first type has a tensile breaking strength of at least about 25 g/Denier.

48. The article as in claim 47, wherein the fiber of the first type has a tensile breaking 20 strength of at least about 30 g/Denier.

49. The article as in claim 44, wherein the fiber of the first type is formed of a material selected from the group consisting of: para-aramids; liquid crystal polyesters; ultra-high molecular weight polyethylenes; and poly(p-phenylene-2,6-benzobisoxazole) 25 (PBO).

50. The article as in claim 44, wherein the fiber bundle is formed of a plurality of fibers including at least one fiber of a first type having a tensile breaking strength of at least about 10g/Denier and at least one fiber of a second type having a tensile breaking of 30 at least about 10g/Denier.

51. The article as in claim 44, wherein the fiber bundle is formed of a plurality of fibers including at least one fiber of a first type having a tensile breaking strength of at least about 10g/Denier and at least one fiber of a second type having a tensile breaking strength less than about 10 g/Denier.

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52. The article as in claim 51, wherein the fiber of the second type is formed of a material selected from the group consisting of: polyamides; cellulosic materials; polyesters; acrylic polymers; and polyolefins.

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53. The article as in claim 51, wherein the fiber of the second type has a tensile breaking strength less than about 8 g/Denier.

54. The article as in claim 53, wherein the fiber of the second type has a tensile breaking strength less than about 5 g/Denier.

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55. The article as in claim 54, wherein the fiber of the second type has a tensile breaking strength less than about 3 g/Denier.

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56. The article as in claim 51, wherein the weight per unit length of the fiber of the second type is less than the weight per unit length of the fiber of the first type.

57. The article as in claim 51, wherein the weight per unit length of the fiber of the first type does not exceed about 5 Denier per fiber.

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58. The article as in claim 57, wherein the weight per unit length of the fiber of the first type does not exceed about 2.5 Denier per fiber.

59. The article as in claim 58, wherein the weight per unit length of the fiber of the first type does not exceed about 1.5 Denier per fiber.

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60. The article as in claim 59, wherein the weight per unit length of the fiber of the first type does not exceed about 1 Denier per fiber.

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61. The article as in claim 60, wherein the weight per unit length of the fiber of the first type does not exceed about 0.5 Denier per fiber.

5 62. The article as in claim 51, wherein the weight per unit length of the fiber of the second type does not exceed about 1.2 Denier per fiber.

63. The article as in claim 62, wherein the weight per unit length of the fiber of the second type does not exceed about 0.8 Denier per fiber.

10 64. The article as in claim 63, wherein the weight per unit length of the fiber of the second type does not exceed about 0.5 Denier per fiber.

15 65. The article as in claim 64, wherein the weight per unit length of the fiber of the second type does not exceed about 0.25 Denier per fiber.

66. The article as in claim 65, wherein the weight per unit length of the fiber of the second type does not exceed about 0.1 Denier per fiber.

20 67. The article as in claim 51, wherein the fiber bundle is formed of a plurality of fibers at least 5% of which are fibers of the first type.

68. The article as in claim 44, wherein the fiber bundle has a length per unit weight exceeding about 55 Cotton Count and a weight per unit length less than about 97 Denier.

25 69. The article as in claim 68, wherein the fiber bundle has a length per unit weight exceeding about 60 Cotton Count and a weight per unit length less than about 89 Denier.

70. The article as in claim 69, wherein the fiber bundle has a length per unit weight exceeding about 70 Cotton Count and a weight per unit length less than about 76 Denier.

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71. The article as in claim 70, wherein the fiber bundle has a length per unit weight exceeding about 80 Cotton Count and a weight per unit length less than about 66 Denier.

5 72. The article as in claim 71, wherein the fiber bundle has a length per unit weight exceeding about 85 Cotton Count and a weight per unit length less than about 63 Denier.

73. The article as in claim 44, wherein the fiber bundle comprises a plurality of spun staple fibers.

10 74. The article as in claim 73, wherein the fiber bundle is formed by a Cotton System spinning process and the length of the staple fibers does not exceed about 2 inches.

75. The article as in claim 73, wherein the fiber bundle is formed by a Worsted System spinning process and the length of the staple fibers exceeds about 2 inches.

15 76. The article as in claim 73, wherein the fiber bundle has a primary twist multiplier of at least about 2.7.

77. The article as in claim 76, wherein the fiber bundle has a primary twist multiplier of at least about 4.

20 78. The article as in claim 77, wherein the fiber bundle has a primary twist multiplier of at least about 4.5.

25 79. The article as in claim 78, wherein the fiber bundle has a primary twist multiplier of at least about 5.

80. A yarn comprising the fiber bundle as recited in claim 44.

30 81. A fabric comprising the yarn as recited in claim 80.

82. An article of apparel formed, at least in part, from the fabric as recited in claim
81.

83. The article of apparel as in claim 82, wherein the article of apparel is selected
5 from the group consisting of: gloves; aprons; chaps; pants; boots; gators; shirts; jackets;
coats; socks; shoes; undergarments; vests; waders; hats; and gauntlets.

84. A method comprising the step of:
forming a fiber bundle having a weight per unit length of less than about 50
10 Cotton Count or less than about 105 Denier from a plurality of fibers including at least
one high tenacity fiber having a tensile breaking strength of at least about 10g/Denier.

85. The method as in claim 84, wherein the fiber bundle is formed by spinning
together a plurality of staple fibers having a length not exceeding about 2 inches utilizing
15 Cotton System spinning.

86. The method as in claim 84, wherein the fiber bundle is formed by spinning
together a plurality of staple fibers having a length exceeding about 2 inches utilizing
Worsted System spinning.

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87. An article comprising:
at least one fiber of a first type having a tensile breaking strength of at least about
10 g/Denier; and
at least one fiber of a second type having a tensile breaking strength of at least
25 about 10 g/Denier, the at least one fiber of the first type and the at least one fiber of the
second type bundled together in a fiber bundle.

88. The article as in claim 87, wherein at least one of the fiber of the first type and
the fiber of the second type have a tensile breaking strength of at least about 15 g/Denier.

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89. The article as in claim 88, wherein at least one of the fiber of the first type and
the fiber of the second type have a tensile breaking strength of at least about 20 g/Denier.

90. The article as in claim 89, wherein at least one of the fiber of the first type and the fiber of the second type have a tensile breaking strength of at least about 25 g/Denier.

5 91. The article as in claim 90, wherein at least one of the fiber of the first type and the fiber of the second type have a tensile breaking strength of at least about 30 g/Denier.

92. The article as in claim 87, wherein at least one of the fiber of the first type and the fiber of the second type is formed of a material selected from the group consisting of:

10 para-aramids; liquid crystal polyesters; ultra-high molecular weight polyethylenes; and poly(p-phenylene-2,6-benzobisoxazole) (PBO).

93. The article as in claim 87, further comprising at least one fiber of a third type having a tensile breaking strength of less than about 10 g/Denier.

15 94. The article as in claim 93, wherein the fiber of the third type is formed of a material selected from the group consisting of: polyamides; cellulosic materials; polyesters; acrylic polymers; and polyolefins.

20 95. The article as in claim 87, wherein the fiber bundle is formed of a plurality of spun staple fibers.

96. The article as in claim 95, wherein the fiber bundle is formed by a Cotton System spinning process and the length of the staple fibers does not exceed about 2 inches.

25 97. The article as in claim 95, wherein the fiber bundle is formed by a Worsted System spinning process and the length of the staple fibers exceeds about 2 inches.

98. The article as in claim 95, wherein the fiber bundle has a primary twist multiplier

30 of at least about 2.7.

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99. The article as in claim 98, wherein the fiber bundle has a primary twist multiplier of at least about 4.

100. The article as in claim 99, wherein the fiber bundle has a primary twist multiplier of at least about 4.5.

101. The article as in claim 100, wherein the fiber bundle has a primary twist multiplier of at least about 5.

10 102. A yarn comprising the fiber bundle as recited in claim 87.

103. A fabric comprising the yarn as recited in claim 102.

104. An article of apparel formed, at least in part, from the fabric as recited in claim
15 103.

105. The article of apparel as in claim 104, wherein the article of apparel is selected from the group consisting of: gloves; aprons; chaps; pants; boots; gators; shirts; jackets; coats; socks; shoes; undergarments; vests; waders; hats; and gauntlets.

20 106. A method comprising the step of:

forming a fiber bundle from at least one high tenacity fiber of a first type having a tensile breaking strength of at least about 10g/Denier, and at least one high tenacity fiber of a second type having a tensile breaking strength of at least about 10g/Denier.

25 107. The method as in claim 106, wherein the fiber bundle is formed by spinning together a plurality of staple fibers having a length not exceeding about 2 inches utilizing Cotton System spinning.

30 108. The method as in claim 106, wherein the fiber bundle is formed by spinning together a plurality of staple fibers having a length exceeding about 2 inches utilizing Worsted System spinning.

109. An article comprising:

a fiber bundle formed of a plurality of fibers, at least about 5% of the plurality of fibers comprising fibers having a tensile breaking strength of at least about 10 g/Denier, and at least one fiber of the plurality having a tensile breaking strength of less than about 5 10 g/Denier.

110. The article as in claim 109, wherein at least 10% of the plurality of fibers have a tensile breaking strength of at least about 10 g/Denier.

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111. The article as in claim 110, wherein at least 20% of the plurality of fibers have a tensile breaking strength of at least about 10 g/Denier.

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112. The article as in claim 111, wherein at least 50% of the plurality of fibers have a tensile breaking strength of at least about 10 g/Denier.

113. The article as in claim 112, wherein at least 65% of the plurality of fibers have a tensile breaking strength of at least about 10 g/Denier.

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114. The article as in claim 113, wherein at least 75% of the plurality of fibers have a tensile breaking strength of at least about 10 g/Denier.

115. The article as in claim 114, wherein at least 85% of the plurality of fibers have a tensile breaking strength of at least about 10 g/Denier.

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116. The article as in claim 109, wherein at least about 5% of the plurality of fibers comprise fibers having a tensile breaking strength of at least about 15 g/Denier.

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117. The article as in claim 116, wherein at least about 5% of the plurality of fibers comprise fibers having a tensile breaking strength of at least about 20 g/Denier.

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118. The article as in claim 117, wherein at least about 5% of the plurality of fibers comprise fibers having a tensile breaking strength of at least about 25 g/Denier.

119. The article as in claim 118, wherein at least about 5% of the plurality of fibers

5 comprise fibers having a tensile breaking strength of at least about 30 g/Denier.

120. The article as in claim 109, wherein the at least about 5% of the plurality of fibers comprising fibers having a tensile breaking strength of at least about 10 g/Denier are formed of a material selected from the group consisting of: para-aramids; liquid crystal polyesters; ultra-high molecular weight polyethylenes; and poly(p-phenylene-2,6-benzobisoxazole) (PBO).

121. The article as in claim 109, wherein at least one fiber of the plurality has a tensile breaking strength of less than about 8 g/Denier.

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122. The article as in claim 121, wherein at least one fiber of the plurality has a tensile breaking strength of less than about 5 g/Denier.

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123. The article as in claim 122, wherein at least one fiber of the plurality has a tensile breaking strength of less than about 3 g/Denier.

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124. The article as in claim 109, wherein the at least one fiber of the plurality having a tensile breaking strength of less than about 10 g/Denier is formed of a material selected from the group consisting of: polyamides; cellulosic materials; polyesters; acrylic polymers; and polyolefins.

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125. The article as in claim 109, wherein the fibers having a tensile breaking strength of at least about 10 g/Denier each have a weight per unit length exceeding that of the at least one fiber having a tensile breaking strength of less than about 10 g/Denier.

126. The article as in claim 109, wherein the fiber bundle is formed of a plurality of spun staple fibers.

127. The article as in claim 126, wherein the fiber bundle is formed by a Cotton System spinning process and the length of the staple fibers does not exceed about 2 inches.

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128. The article as in claim 126, wherein the fiber bundle is formed by a Worsted System spinning process and the length of the staple fibers exceeds about 2 inches.

129. The article as in claim 126, wherein the fiber bundle has a primary twist 10 multiplier of at least about 3.

130. The article as in claim 129, wherein the fiber bundle has a primary twist multiplier of at least about 4.

15 131. The article as in claim 130, wherein the fiber bundle has a primary twist multiplier of at least about 4.5.

132. The article as in claim 131, wherein the fiber bundle has a primary twist multiplier of at least about 5.

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133. A yarn comprising the fiber bundle as recited in claim 109.

134. A fabric comprising the yarn as recited in claim 133.

25 135. An article of apparel formed, at least in part, from the fabric as recited in claim 134.

136. The article of apparel as in claim 135, wherein the article of apparel is selected 30 from the group consisting of: gloves; aprons; chaps; pants; boots; gators; shirts; jackets; coats; socks; shoes; undergarments; vests; waders; hats; and gauntlets.

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137. A method comprising the step of:

forming a fiber bundle from a plurality of fibers, at least about 5% of the plurality of fibers comprising high tenacity fibers having a tensile breaking strength of at least about 10g/Denier and at least one fiber of the plurality having a tensile breaking strength of less than about 10g/Denier.